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Doppler wind lidar using a MOPA semiconductor laser at stable single-frequency operation

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Our group has recently demonstrated that a compact master-oscillator power-amplifier semiconductor laser (MOPA-SL) is a good candidate for a coherent light source (operating at 1550 nm) in a Doppler wind Lidar [1]. The MOPA-SL requires two injection currents: I_{DFB} for the distributed-feedback (DFB) laser section (master oscillator) and I_{AMP} for the tapered amplifier section. For our laser, the specified maximum current values are 0.7 A and 4.0 A for I_{DFB} and I_{AMP}, respectively. Figure 1(a) shows the measurement of CW output power of the MOPA-SL versus I_{AMP} for three different values of I_{DFB} = 400, 500, and 600 mA. Our measurements were taken at 19 ºC set temperature. The L-I curve shows that the output power linearly increases with I_{AMP} and reaches an ample 1 W level. Although the MOPA-SL has been proven capable of producing single-frequency CW output beam, stable operation at this spectral condition has also been known to highly depend on the drive currents to the laser [2]. It is therefore important to identify pockets of stability in the I_{DFB}-I_{AMP}-T_S (T_S = laser set temperature) space where lasting single-frequency operation is achieved. At a chosen set temperature T_S = 19 ºC, we searched for combinations of (I_{DFB}, I_{AMP}) where the laser operates stably at single-frequency. This was done by observing the spectral characteristic of the laser using an optical spectrum analyzer (OSA, ANDO AQ6315) at different drive current combinations. The resolution of the OSA used is 0.05 nm. Depending on the drive currents, single-frequency or multi-frequency operations of the laser may occur as shown in Fig 1(b). Furthermore, hysteretic mode-hops between single-frequency regimes can occur at higher values of I_{AMP}. When using the laser for a Doppler wind Lidar application, a combination of (I_{DFB}, I_{AMP}) which is close to the center of an identified stable single-frequency regime is used. For the MOPA-SL unit that we use in our Lidar, we typically use (I_{DFB} = 0.5 A, I_{AMP} = 3.0 A) at T_S = 19 ºC. These current settings for the laser result in a highly stable Lidar as shown by a 5-day long continuous measurement of the Doppler shift produced by a constantly rotating diffusely reflecting target (Fig. 2).

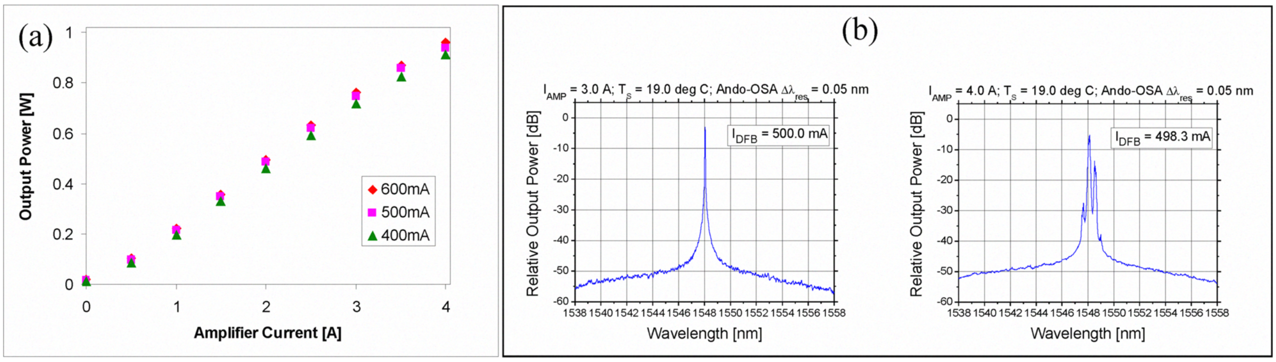

Fig. 1. Characterization of the MOPA-SL's (a) output power and (b) spectral properties for different drive currents.

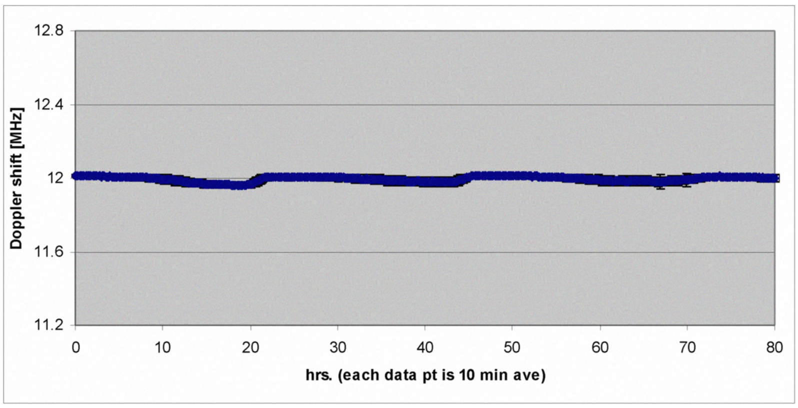

Fig. 2. Lidar-measured 10-minute average Doppler shift (~12 MHz) produced by a hard-target rotating at constant rate. Standard deviations of <0.1 MHz for any data point is indicative of the high stability of the laser source over an 80-hour period.

References

[1] R. S. Hansen and C. Pedersen, "All semiconductor laser Doppler anemometer at 1.55 μm," Opt. Express **16**, 18288 (2008).
[2] A Egan, et al., "Dynamic Instabilities in Master Oscillator Power Amplifier Semiconductor Lasers," IEEE J. Quantum Electron. **34**, 166 (1998).

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